The Surgical Management of Paraduodenal Hernia

MARSHALL K. BARTLETT, M.D., CHIU-AN WANG, M.D.,
WILLIS H. WILLIAMS, M.D.

From the Surgical Services of the Massachusetts General Hospital and the Department of Surgery of the Harvard Medical School

PARADUODENAL hernia is a rare congenital anomaly which arises from an error of rotation of the midgut. It may be discovered as an incidental finding at laparotomy or may be the cause of acute small bowel obstruction which can go on to strangulation and perforation. Its presence may also lead to confusion and errors in the performance of other abdominal operations, although itself not the cause of any symptoms.

Much attention had been given in the earlier surgical literature to internal herniae involving the various intra-abdominal fossae, but it was not until the report of Andrews,[1] in 1923, that the true embryological abnormality involved in the production of paraduodenal hernia was clearly recognized. He added 60 cases from the literature and one of his own to the 74 previously collected by Moynihan[3] in 1906. Zimmerman and Laufman[5] added 4 cases in 1953, again giving an excellent description of the condition. Five cases from the Massachusetts General Hospital since 1941 have been mentioned in a previous report.[4] In one the diagnosis was made by x-ray but no operation was done. The other four, and one additional case, encountered recently, are here described in more detail.

Embryology

The midgut is that portion of the intestinal tract receiving its blood supply from the superior mesenteric artery and includes the distal duodenum, jejunum, ileum, cecum, ascending colon and the proximal half of the transverse colon. It is divided into two segments. The portion cephalic to the vitello-mesenteric duct is called the prearterial segment and that caudad the postarterial segment. The former comprises the distal duodenum and all of the small bowel to the distal ileum, and the latter the distal ileum, ascending and transverse colon.

In the normal sequence of events the midgut, suspended in the midline by its dorsal mesentery, passes through an orderly pattern of rotation. This process is arbitrarily divided into 3 stages. The *first* stage begins at about the fifth week of life of the embryo. Rapid growth of the abdominal viscera forces a great portion of the elongating midgut out of the abdominal cavity into the umbilical or yolk sac. By about the tenth week the abdominal cavity has increased in size and the midgut has gradually returned within it, beginning the *second* stage of rotation. The midgut has now rotated 90 degrees in a counterclockwise direction on the axis of the superior mesenteric artery. The prearterial segment occupies the right side, and the postarterial segment the left side of the abdominal cavity. Arrest at this point of rotation produces the relatively common picture of "non-rotation of the intestine," where the small bowel, including the duodenum, lies entirely to the right, and the colon to the left of the midline of the abdominal cavity. Normally, the prearterial segment con-

Submitted for publication January 29, 1968.

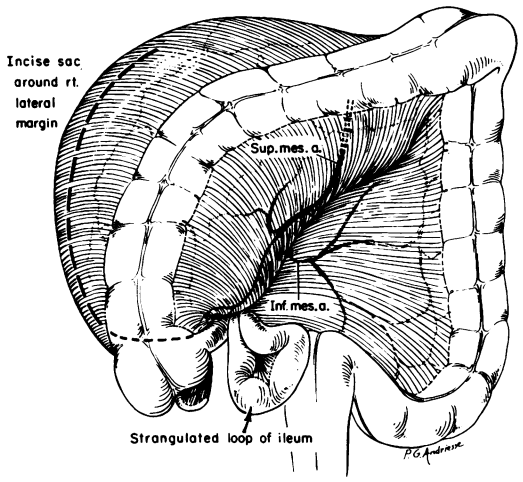

FIG. 1. Right paraduodenal hernia. The counter clockwise rotation of the small intestine is arrested on the right side of the abdomen. The cecum and ascending colon rotate anterior to the small intestine which is trapped in a sac, lined by peritoneum, behind the mesentery carrying the blood vessels of the colon. The terminal ileum comes through a small opening in the sac to reach the cecum. An additional loop of small intestine can prolapse through this opening and become incarcerated or strangulated.

tinues to rotate through an additional arc of 180 degrees counterclockwise, first behind and then to the left of the superior mesenteric artery, so that it comes to lie to the left of the midline in the abdominal cavity. The postarterial segment also rotates, led by the cecum, which passes counterclockwise anterior to the superior mesenteric artery into the right upper quadrant, where it remains for a time. The entire second stage is a rapid process and takes place between the tenth and eleventh week, but the cecum may not complete its descent to its normal position in the right lower quadrant until about the end of the fifth month of the life of the embryo. This second stage is a very important one in which many of the anomalies of rotation arise.

The *third* stage is one of fusion of the mesenteries and fixation of the midgut. The leaf of the mesentery of the colonic portion of the midgut, which has come to be in a posterior position, fuses with the peritoneum of the posterior abdominal wall and the space between them is obliterated. The mesentery of the small bowel remains fixed to the posterior abdominal wall and the mesentery of the duodenum fuses with the posterior parietal peritoneum.

If the prearterial segment fails to rotate properly, it may become trapped under the mesentery of the rotating colon forming an internal hernia which, because of its proximity to the duodenum, has been called a paraduodenal hernia. This then consists of a sac lined by peritoneum containing small intestine with a small opening through which the distal ileum passes into the free peritoneal cavity to join the cecum. This may occur on either the right or left side of the abdomen, depending on the exact nature of the error of rotation.

The mechanism of production of the right paraduodenal hernia is quite simple. As the midgut returns from the yolk sac to the abdominal cavity, the small bowel has rotated 90 degrees counterclockwise and lies on the right side of the abdomen. It does not participate further, however, in the second stage of rotation, remaining on the right side, so that as the terminal ileum, cecum and colon proceed with their normal course of rotation across to the right they come to lie anterior to the distal duodenum and small bowel of the prearterial segment. Fixation of the cecum and colon to the posterior parietal peritoneum occurs but leaves the small bowel trapped in a sac, lined by the peritoneum, which lies behind the mesentery of the postarterial segment, in the anterior wall of which are the ileocolic, right and midcolic vessels. The terminal ileum emerges from the sac through a small opening into the free peritoneal cavity to reach the cecum (Fig. 1).

The process of formation of a left paraduodenal hernia is somewhat more complicated. A clear description of the mechanism was given by Callander *et al.*[2] in 1935, which best explains the anatomical findings.

As the prearterial segment of the midgut rotates in the normal pattern, first behind and then to the left of the superior mesenteric artery, and comes to lie in the left side of the abdomen, it invaginates into an unsupported area of descending mesocolon, the anterior margin of which is formed by the ascending branch of the inferior mesenteric artery and the inferior mesenteric vein as it ascends to join the splenic vein (vascular arch of Treitz). The small bowel thus comes to lie in a sac, lined by peritoneum, behind the mesentery of the descending colon as this structure undergoes its normal posterior fixation. The inferior mesenteric artery, with its ascending branch, and the inferior mesenteric vein are in the margin of the neck of this sac, and the blood supply of the descending colon is in the wall of the sac. The terminal ileum comes into the free peritoneal cavity through the neck of the sac to reach the cecum (Fig. 3).

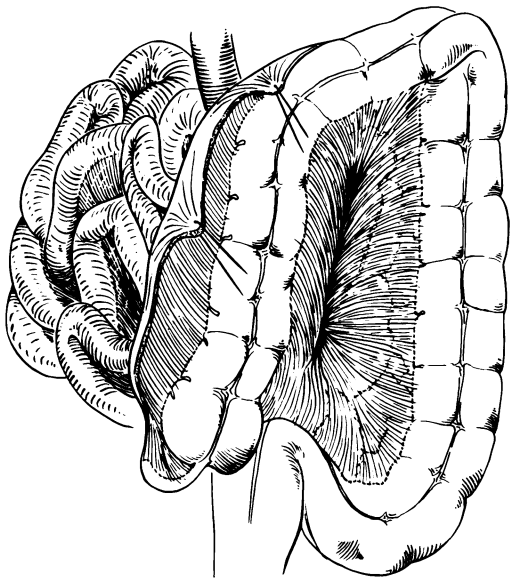

FIG. 2. Right paraduodenal hernia. When the lateral peritoneal attachments of the right colon are freed and the colon is reflected to the left, the small opening through which the terminal ileum passed is eliminated and the hernia sac becomes part of the general peritoneal cavity. The relations of the small and large intestine are now those seen in "nonrotation."

Diagnosis

In many cases paraduodenal hernia causes no symptoms. The diagnosis should be suspected if barium x-ray examination shows all of the small bowel loops to lie either to the right or left of the mid-line in the abdomen. If encountered as an incidental finding at laparotomy done for other reasons, the distorted anatomy can present unsurmountable difficulties to the uninitiated, and even in the hands of the experienced surgeon it can pose a challenge. Improper anatomic identification of the structures involved may lead to serious technical errors.

At times the sac-enclosed small intestine may form a palpable mass and this may lead to exploratory laparotomy. Under these circumstances the paraduodenal hernia, if asymptomatic, need not necessarily be corrected.

Intestinal obstruction is the commonest cause of symptoms due to a paraduodenal hernia. This may be due to adhesions within the sac or to prolapse of a loop of small intestine through the small opening which allows passage of the terminal ileum into the free peritoneal cavity. Incarceration and strangulation of the involved loop may follow. The symptoms are the usual ones of small bowel obstruction, with crampy abdominal pain, nausea, vomiting and distension. A plain film of the abdomen will usually show an agglomeration of dilated loops of small bowel into one area. Barium enema examination may show a normal colon in its usual anatomical position or the cecum may be only incompletely rotated and lie in the right upper quadrant. The dilated loops of small bowel may be sufficiently localized so that diagnosis of paraduodenal hernia could be considered, but this may not be recognized before operation.

Treatment

If it is necessary to correct the paraduodenal hernia it is essential to recognize

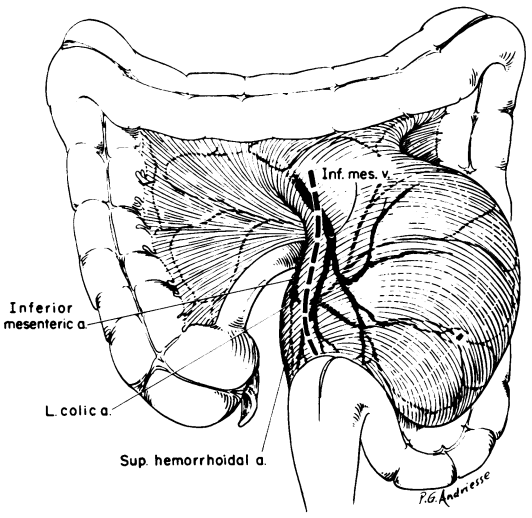

FIG. 3. Left paraduodenal hernia. The small intestine, in the course of its rotation into the left side of the abdomen, has invaginated under the vascular arch formed by the inferior mesenteric artery and vein and lies in a peritoneum-lined sac behind the mesentery of the descending colon. The terminal ileum passes through a narrow opening under the vascular arch to reach the cecum. The dotted line shows the incision used.

whether it has occurred on the right or left side, since the technical problem involved is quite different.

In the case of a right paraduodenal hernia the aim should be to replace the pre- and postarterial segments of the intestine in the positions they would normally occupy at the end of the first stage of rotation, with the duodenum, jejunum, and most of the ileum to the right and the terminal ileum, cecum and colon on the left of the midline. This is the relation of these structures in the relatively common "non-rotation of the intestine" and eliminates the small opening from the hernia sac through which the terminal ileum passes and through which additional loops of small bowel may prolapse (Fig. 2).

This is accomplished by dividing the lateral attachments of the colon on the right side and transferring it to the left side of the abdomen. In so doing the hernia sac is widely opened and the small opening through which the terminal ileum passes is eliminated. The hernia sac is now a part of the general peritoneal cavity. The superior mesenteric artery and its branches to the cecum and ascending colon lie in the anterior wall of the hernia sac. Injury to these vessels may result if reduction of the hernia is attempted by opening the sac in this area.

In dealing with a left paraduodenal hernia, manual reduction of the small bowel from the hernia sac into the peritoneal cavity may occasionally be possible, followed by closure of the sac opening. More usually the neck of the sac is small, obscured by adhesions and difficult to identify accurately. In such a case the hernia sac should be opened by an incision into an avascular area of the mesentery of the descending colon, allowing the small bowel to be delivered into the peritoneal cavity. It is essential that the tight ring through which the terminal ileum passes to reach the cecum be released by division of the inferior mesenteric artery, or its ascending branch, and the inferior mesenteric vein. This will allow the hernia sac to become, in effect, a part of the general peritoneal

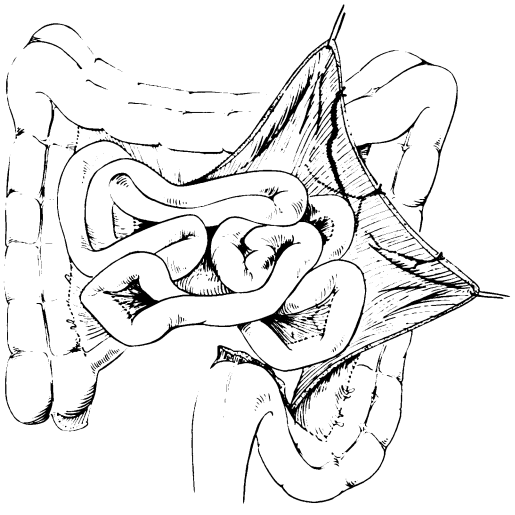

FIG. 4. Left paraduodenal hernia. The narrow neck of the hernia sac, through which the terminal ileum passes to reach the cecum, is opened by dividing the inferior mesenteric artery, or its ascending branch, and the inferior mesenteric vein. The trapped small intestine is then delivered into the free peritoneal cavity.

cavity, and restore the pre- and postarterial segments of the midgut to their normal anatomical relationships (Fig. 4).

Case Reports

Case 1. (MGH #141248.) A 68-year-old retired businessman was admitted because of persistent abdominal pain of 15 hours' duration. On the afternoon before admission he began to have frequent episodes of diarrhea followed by crampy abdominal pain, nausea, and vomiting which persisted.

On entry the patient appeared dehydrated. The abdomen was distended and tympanitic. There was moderate diffuse tenderness without spasm. Peristaltic sounds were high-pitched. The liver and spleen were not palpable. Rectal examination showed no mass or tenderness. Stool guiac was negative. General physical examination was otherwise not remarkable. Plain abdominal x-ray film showed all the dilated small bowel loops present in the right upper quadrant. Barium enema showed a few sigmoid diverticula and an abnormally low hepatic flexure (Fig. 5).

After appropriate fluid replacement a preoperative diagnosis of small bowel obstruction was followed by laparotomy. A typical right paraduodenal hernia was found with all of the small bowel in a sac behind the right mesocolon. A loop of some 4 feet of ileum had prolapsed through a small opening adjacent to the cecum where the terminal ileum passed from the sac in to the free peritoneal cavity. The entire large bowel was displaced downward. The right half of the colon was mobilized from its parietal attachment and transposed to the left. This opened the ring surrounding the strangulated loop of bowel, which was viable. The appendix was removed and recovery was uneventful.

Comment: This was a typical right paraduodenal hernia with all of the prearterial segment of the midgut in the sac. The strangulated obstruction was easily reduced by the method described.

Case 2. (MGH #331601.) A 45-year-old man was admitted for operation because of an exacerbation of symptoms from a pyloric channel ulcer, which had been intractable on a medical program. At operation an unusually short transverse mesocolon was noted with a matted mass of small bowel within an antecolic sac. A distal subtotal gastrectomy with what was thought to be a posterior gastrojejunostomy was done. On the third

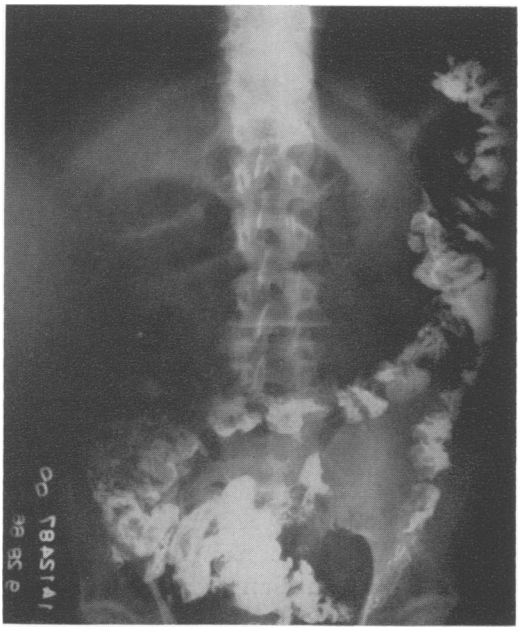

FIG. 5. Radiologic findings in Case 1. The small bowel lies entirely on the right side of the abdomen and the right and transverse segments of the colon are displaced downward.

postoperative day fecal content was noted in the gastric aspirate and the patient developed copious loose bowel movements. Barium x-ray studies showed a gastroileostomy about a foot from the cecum. At reoperation the gastroileostomy was taken down; a left paraduodenal hernia was found. The sac was incised and the small bowel freed. A gastrojejunostomy was then done. A good recovery followed.

Comment: This was a left paraduodenal hernia which was not recognized at the first operation resulting in a serious technical error in the placement of the gastroenterostomy. It was, fortunately, recognized and corrected.

Case 3. (MGH #798276.) A 75-year-old woman was operated on because of a carcinoma of the hepatic flexure of the colon. At operation a right paraduodenal hernia containing the entire small bowel was found. Mobilizing the right half of the colon opened the hernia sac widely and allowed appropriate resection. Postoperatively the patient ran a febrile course and died 21 days later of gram negative septicemia. Autopsy showed thrombosis of the inferior vena cava and pulmonary emboli.

Comment: The presence of the right paraduodenal hernia was recognized and managed, allowing the appropriate resection to be done. The presence of the hernia does not appear to have contributed to the fatal outcome.

Case 4. (MGH #284120.) A 41-year-old woman was operated upon for a prepyloric ulcer after 3 years of unsuccessful medical treatment. Preliminary barium x-rays suggested a left paraduodenal hernia because all of the small bowel loops lay to the left of the midline. This was confirmed at operation and distal gastrectomy and gastroduodenotomy were done uneventfully.

Comment: Since it was possible to use the duodenum for the anastomosis after gastric resection it was not necessary to do anything about the paraduodenal hernia. Vagotomy was not an accepted procedure at the time this operation was done.

Case 5. (MGH #948318.) A 44-year-old man was operated upon for a duodenal ulcer after 16 years of unsuccessful treatment. The presence of the ulcer was confirmed by barium x-ray studies, which also showed an incompletely rotated cecum. At operation a right paraduodenal hernia was found and a drainage procedure consisting of gastroduodenostomy was done for the duodenal ulcer.

Comment: A gastric resection would have been the usual treatment for duodenal ulcer at the time this operation was done. A vagotomy would surely have been added to this drainage operation at the present time.

Summary and Conclusions

1. Paraduodenal hernia is a rare congenital anomaly arising from an error of rotation of the midgut. The duodenum and small intestine become trapped in a sac, lined by peritoneum, behind the mesentery of the colon, either to the right or left of the midline.

2. This may be an incidental discovery at laparotomy or the patient may have a palpable abdominal mass or small bowel obstruction which may progress to strangulation and perforation.

3. Paraduodenal hernia is usually diagnosed at laparotomy. It may be suspected on preoperative x-ray examination if the small bowel loops are all on the right or on the left of the midline. Barium enema x-ray may show the cecum in a normal position or it may be incompletely rotated.

4. If treatment is indicated the nature and character of the hernia must be clearly defined. It must include careful inspection of the vascular pattern and the contents of the hernia sac. Elimination of the narrow opening through which the terminal ileum passes to reach the cecum is essential. The technical problem is quite different depending on whether the hernia has occurred on the right or left side.

5. Failure of the surgeon to recognize the nature of this anomaly, when it is encountered, may lead to serious technical errors.

6. Five cases of paraduodenal hernia, seen at the Massachusetts General Hospital between 1941 and 1966 are reported.

References

1. Andrews, E.: Duodenal Hernia, a Misnomer. Surg. Gynec. Obstet., **37**:740, 1923.
2. Callander, C. L., Rusk, G. Y. and Nemir, A.: Mechanism Symptoms and Treatment of Hernia into the Descending Mesocolon (Left Duodenal Hernia). A Plea for a Change in Nomenclature. Surg. Gynec. Obstet., **60**:1052, 1935.
3. Moynihan, B. G. A.: Retroperitoneal Hernia. William Wood & Co., pp. 36–59, 1906.
4. Wang,, C. A. and Welch, C. E.: Anomalies of Intestinal Rotation in Adolescents and Adults. Surgery, **54**:839, 1963.
5. Zimmerman, L. M. and Laufman, H. L.: Intra-abdominal Hernias Due to Developmental and Rotational Anomalies. Ann. Surg., **138**: 82, 1953.